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David White (W.E.) *et al.*, "MicroPPT Development for Small Spacecraft Propulsion"

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(Statement A)

MicroPPT Development for Small Spacecraft Propulsion

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ABSTRACT

A class of miniaturized pulsed plasma thrusters (PPT), known as MicroPPTs,^{1,2} is currently in development at the Air Force Research Laboratory. Operating by means of a surface discharge across a Teflon™ propellant fuel bar only a few millimeters in diameter, the MicroPPT delivers a thrust-to-power ratio of 5–10 $\mu\text{N-s/J}$. In the near term, these thrusters can provide propulsive attitude control on 150-kg-class spacecraft using 1/5th the dry mass of conventional torque rods and reaction wheels. Eventually these thrusters are designed for primary and attitude control propulsion on future 25-kg class spacecraft. Efforts to characterize MicroPPT performance and the thruster plume are underway. To this end, a modified torsional thrust stand has been developed for the purpose of accurately measuring the low-level thrust generated by the MicroPPT. A Herriott Cell interferometer is introduced to establish the plume electron and neutral densities. Comparison of the measured electron density with modeling predictions shows close agreement. Additionally, a Pockels cell has been developed to provide a zero-impedance MicroPPT breakdown voltage measurement, and an intensified CCD array has been used to characterize the divergence of both the thruster plume and the late-time particulate emission. A synopsis is also presented of the status of the thruster development, including lifetime, thermal, and environmental testing.

¹ Spanjers, Gregory G., "Micro Pulsed Plasma Thruster having Coaxial Cable Segment Propellant Modules," Patent Number US 6,269,629 awarded Aug 7, 2001.

² Spanjers, Gregory G., "Self-Triggering Micro Pulsed Plasma Thruster," Provisional US Patent 09/518,164, March 6, 2000.